Development of a Wireless Control Based Control System of a Wheelchair

For Physically Disabled Person

Thesis submitted in fulfillment of the requirement of the Degree of

BACHELOR OF TEHCNOLOGY

IN

BIOMEDICAL ENGINEERING

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CERTIFICATE

This is to certify that the thesis entitled "**Development of a Wireless Based Control System of A Wheelchair For Disabled Person**" submitted by **Abhishek Kumar Gupta (111BM0007)** in the partial fulfillment of the requirements for the award of Bachelor of Technology degree in Biomedical Engineering at National Institute of Technology, Rourkela is an authentic work carried out by them under my supervision and guidance. To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other University/Institute for the award of any Degree or Diploma.

Date:

Place:

Prof. Kunal Pal

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ABSTRACT

The Wheelchair is widely used all over the world to help the population with disabilities like hemiplegia, paraplegia and accidental case of the some persons, but with using technology we can further enhance the ability and the power of a mechanically based wheelchair to work as a robot for the disabled person. Using an Android application to control the wheelchair wirelessly because android phone now days are available to everyone, large number of population and other technologies are Xbee, Bluetooth and Wi-Fi to communicate with the wheelchair wirelessly Xbee module was so efficient and easy to use for the user of the wheelchair and the range is also favorable to the disable person. Xbee Remote Controller also has been developed to control the wheelchair wirelessly that is so efficient to work with other Xbee modules for wireless communication. Ultrasonic sensor has been used to counter the obstacle in front of the wheelchair movement and prevent any hazardous accident for the user or the disable person and IR Sensor has been used to measure the distance of the obstacle and to counter the steps coming in front of the wheelchair.

Keywords: Wheelchair Movement, Android Application, GPS module, Wi-Fi Module, Bluetooth Module, Ultrasonic sensor.

CHAPTER-1 INTRODUCTION

1.1 Introduction

The work pressure has been highly increased in the last decade for the human being. The people are very busy in their professional life because of the highly increased work pressure. The reason is clear that they cannot spend much more time to take care for the person suffering from hemiplagia and paraplegia disabilities. It is difficult to spend sufficient time for the disabled person.Hiring Nurses is expensive for taking care of the patient.If all the family members are working, then maybe it is possible to hire, but most people in a family does not work for wage and the later section's population is higher so that they find it difficult to hire another person to take care of the patient suffering from motor disabilities. Current day the cost of living is also too much that a large population find it difficult to survive. Therefore the workload on the guardians is very high, the guardians have to look after the motor disable person returning from the office. Many scientists are working towards the development of the devices for the motor disable persons which can help to minimize the workload of the guardian to a certain extent. Many devices have been developed to help the motor disabled people to perform their daily necessity one example of such a

device [1]. The teleoperated Wheelchair device helps the motor disabled person so that they can perform their daily activity without the help of others.They can operate the wheelchair using wireless remote control while they are at their home and no one is around, but also in hospital environment the disable people can help themselves.Also the nurses are less available in the hospitals to surve a large number of paitents, the teleoperated wheelchair can reduce the burden of the nurses and the guardians because of the different facilities available to the patient with the teleoperated device. The person with disabilities lie all day on the bed, they need help of the other people for their needs like water, food, to go to washroom, etc. with the help of the teleoperated wheelchair they can get water and other needs. Apart from this while not getting the needs at the time the person hygiene is also compromised. For these kind of problem there are also other ways with the teleoperated device, that is to message or call with the same device the motor disable person is using to operate the wheelchair The development of wireless based wheelchair control system, reduce the burden of the working population for disable persons care.Besides, there are extra features or function is provided by the newly Wireless based wheelchair that is beneficial for disable person. The Wireless Wheelchair device uses the

Arduino Mega ADK 2560 (Microcontroller) to perform all the functions which makes the device portability and less complex structure.

1.2 Project's Objective

- To design the development of a Wireless based Wheelchair control system for disabled person.
- To make a Wheelchair safe and comfortable for disable person by using IR and Ultrasonic sensors to detect the obstacles in front of the wheelchair movement as well as controlling the wheelchair through wireless communication and android application to send the message to the parents.
- To make wheelchair innovation that is more flexible and less expensive to market.
- User friendly- simple and complete with instruction

1.3 Literature Review

1.3.1 Introduction

Literature review done according to our project title "Development of a Wireless Control Based Control System of a Wheelchair For Physically Disabled Person" and overview of teleoperated wheelchair control and the research about wheelchair and related works which has been done till now are discussed.

1.3.2 Overview

Generally, the wheelchair is used to help the motor disable person to meet their daily needs. Suppose,a guardian has to take care for their office work and other household works and to look after other things and look after other family members.The Wheelchair is equipped with electronically such like a battery, Xbee remote controller and Andorid Device for Android application. In Addition to that, these kind of Device can be used in villages, areas or non-developed cities due to android application widely used all over the world. But the problem of this kind of designated wheelchair device is that you need manpower to take care of the battery of the wheelchair and the Xbee Remote Controller.

It is followed by an in-depth description of Android development for multimodal control of the wheelchair as well as wireless communication technologies. Furthermore, this chapter concludes with the previous project work performed on the wheelchair platform to get a better understanding of the project at hand.

CHAPTER - 2 MATERIALS AND METHOD

2.1 Manual Design

The wheelchair prototype, which is manually designed requires power supply to operate. The guardian has to use the Xbee remote controller.

Fig.1 : Assembled Device

2.2 HARDWARE DESIGN AND DESCRIPTION

The following section describes the hardware that is being used in the project.

A. Hardware Requirements

1. Ultrasonic sensor

2. Motor shield

3. Arduino Mega ADK 2560

4. GPS Shield

5. IR Sensor

6. Wi-Fi Shield

7. Xbee Shield

8. Bluetooth Shield

2.3 Ultrasonic Sensor

Ultrasonic sensor emits wave(ultrasonic waves), the wave travels in the air and gets reflected from the obstacle.The waves that is reflected by the obstacle comes to the ultrasonic sensor.The speed of sound is already known ~332m/s then while knowing the time taken by the ultrasonic waves to complete the total path that it covers from the ultrasonic sensor and then to obstacle and then back to the sensor we can calculate the distance between the obstacle and the ultrasonic sensor.Using the following formula given below.

$$\text{Distance} = \frac{Speed}{Time}$$

Fig 2: Ultrasonic Sensor

The ultrasonic sensor can be used with the Arduino Mega ADK 2560 to detect the obstacles in front of the wheelchair using the following Arduino Programe Fig 4: Ultrasonic Sensor Arduino Program.

Features

1. The Ultrasonic sensor can be used to detect different varities of objects e.g.
    a) Any Color Object
    b) Transparency of the Object Does not affect the accuracy of the ultrasonic sensor.
    c) The metallic and non-metallic character of the object also does not affect the accuracy of ultrasonic sensor.
2. It can detect upto 4 cm^2 size of objects because the ultrasonic beam width limit is 8 degree.
3. Ultrasonic Sensor detect object easily while there is interference from background objects.
4. Ultrasonic sensors emit ultrasonic waves at frequence of ~200KHz because of this it provides good care from impact and noise.

Applications of Ultrasonic Sensor

1. Used in motion detector.
2. Indoor and outdoor lighting.
3. Military and scientific application.

4. Automatic light control safety.
5. Used for intrusion detection.

2.4 Motor Shield

For the wheelchair prototype the Motor Shield (Figure-4) is one of the most important part.With the help of the motor shield the motors attached with the wheelchair prototype get the programed power to operate according to the Arduino Mega ADK 2560.

The motor shield gives current supply to drive two DC motors with the Arduino MEGA ADK 2650.

Applications of Motor Shield

1. Robotics
2. Mechanical Application.

Fig. 3 Motor Sheild

2.5 Arduino Mega ADK 2560

The Arduino MEGA ADK 2560 is the brain of the wheelchair device.With the help of Arduino Mega Adk 2560, the Xbee Shield, the Wi-Fi shield and motor shield can work altogether and apart from these ultrasonic sensors(for obstacle detection), infrared(distance measurment) sensors can work simultaneously without any interruption. While working on the project initially we have given supply to Arduino Mega ADK 2560 from USB cable of our computer system.

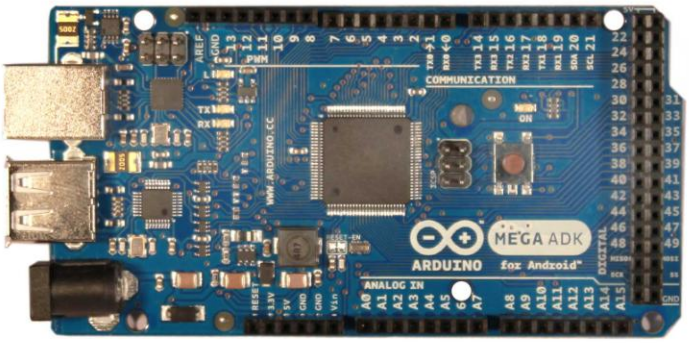

Fig:4 Picture of Arduino

Application of Arduino MEGA ADK 2500

To develop any sensor based prototype equipment. Develop any LED blinking circuit.

Xoscillo: open-source oscilloscope

- Android Phone

- Scientific equipment

2.6 GPS Shield

Global Positioning Service (GPS) is a modern technology that provides us the exact location in the form of latitude and longitude on the planet earth. It sends signals to the global positioning satellite and the geostationary satellite sends back the response as the latitude and longitude coordinate according to which we can decide the location of the place GPS shield is getting used. GPS shield also tells us about the standard time, according to the its position if it is placed in India then it will give time, according to the IST(Indian Standard Time) e.g. 18:20:00,it represents 06:20 PM.

GPS shield also gives garbage values, that we filter using the Arduion program. The Arduino GPS shield is easily attached with the Arduino Mega ADK 2560. The RX and TX pin of the GPS shield is used to collect the data and can be modified to use for getting the location.

FEATURES

- Navigation with the help of GPS shield.
- Personal positioning according to the data given by GPS shield.
- Gives Time and Date according to the its position.

Application

2.9Global Positioning Service.

2.10 Know the exact position.

2.11 Give the time and date according to the GPS shield position.

Fig 5: Arduino GPS Shield

2.7 Xbee Shield

The Xbee is a wireless module to transfer data and for communication from one Xbee to other in 100 feet range (indoor) and 300 feet outdoor. The Xbee shield allows to control the digital and Analoge pins of an Arduino board to communicate wirelessly. Using the Xbee shield the wireless control wheelchair device has been developed It is based on the Xbee module.The Xbee Shield can be used as a serial/USB replacement or we can put it into a command mode and configure it for variety of broadcast and mesh networking options.

Application of Xbee Sheild

1. Used in motion detector.
2. Indoor and outdoor lighting.
3. Military and scientific application.
4. Automatic light control safety.
5. Used for intrusion detection.

2.8 Bluetooth Shield

The Bluetooth Shield used to transfer data and for communication between another Bluetooth shield. The Bluetooth shield has been used in the wheelchair device

Application

1. Used in motion detector.
2. Indoor and outdoor lighting.
3. Military and scientific application.
4. Automatic light control safety.
5. Used for intrusion detection.

Fig-6: Arduino Bluetooth Shield

2.9 Wi-Fi Shield

The Arduino WiFi Shield used to connect to the internet wirelessly with the help of Arduino Mega Adk 2560 using the 802.11 WiFi. The WiFi shield stacked on the top of the Arduino Mega Adk 2560 and above the WiFi shield the Motor Sheild described above can also stacked on the top of the WiFi to control the Motors used in Wheelchair Prototype.These is also a micro SD card slot to save the data for data classification and other uses e.g. the GPS data can be logged to the SD card and then plot on the Google maps. The WiFi shield can be used to send emails and message using the Arduino with the particular arduino coding.

Application

1. Used in motion detector.
2. Indoor and outdoor lighting.
3. Military and scientific application.
4. Automatic light control safety.
5. Used for intrusion detection.

Fig.7 : Arduino WiFi Sheild

Chapter – 3 Results and Discussion

3.1 Ultrasonic Sensor with Arduino to Detect Obstacle

Ultrasonic sensors emit ultrasonic waves in the air that reflect off of objects. The reflected sound is then received by the sensor. This technology is used for detection of objects in burglar alarms and automatic doors as well as for range measurement in automotive parking assistance systems.

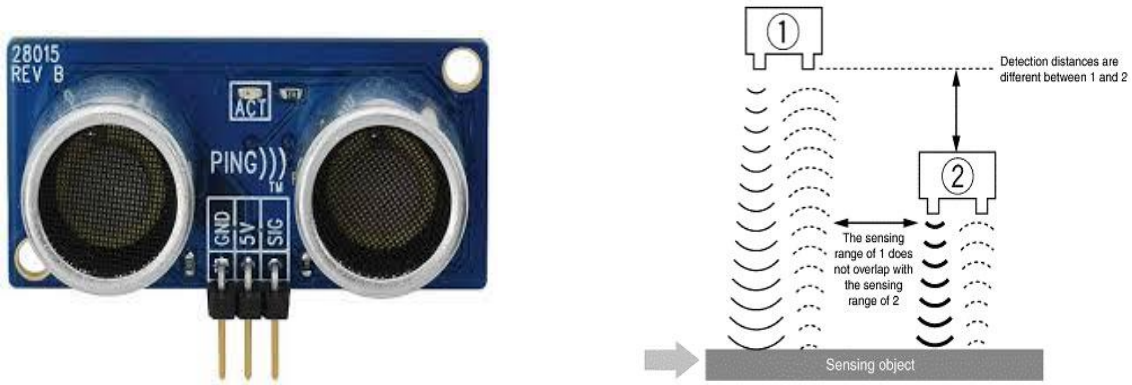

Fig. 8: Ultrasonic sensor and Working Principle [4]

Arduino programming for detection of the obstacle in front of the wheelchair. The C code given below detects the obstacle by measuring the speed of the sound gets reflected from the obstacle and the time taken by the sound calculated using the sensor and the using the time distance formula Distance = Speed/Time the ultrasonic sensor calculates the obstacle distance.

```
void scanObstacleDistance(){
  time = sonar.ping();
  distance = time / US_ROUNDTRIP_CM;
  if(distance == 0){
    distance = 100;
  }
  delay(10);
}
```

```
Ping: 10cm
Ping: 10cm
Ping: 9cm
Ping: 9cm
Ping: 9cm
Ping: 8cm
Ping: 8cm
Ping: 8cm
Ping: 7cm
Ping: 7cm
Ping: 7cm
Ping: 6cm
Ping: 6cm
Ping: 6cm
Ping: 7cm
Ping: 7cm
Ping: 7cm
Ping: 6cm
Ping: 6cm
Ping: 6cm
Ping: 6cm
Ping: 89cm
Ping: 89cm
Ping: 89cm
Ping: 89cm
Ping: 11cm
Ping: 11cm
Ping: 13cm
```

Fig 9:Ultrasonic Sensor Arduino Program Fig 10:Result Obtained from Ultrasonic Sensor

3.2 Testing of the assembled device

The experiments have been performed and the following device has been developed which is capable of controlling the wheelchair prototype wirelessly with the help of the Xbee Remote Contorller shown in the figure given below.

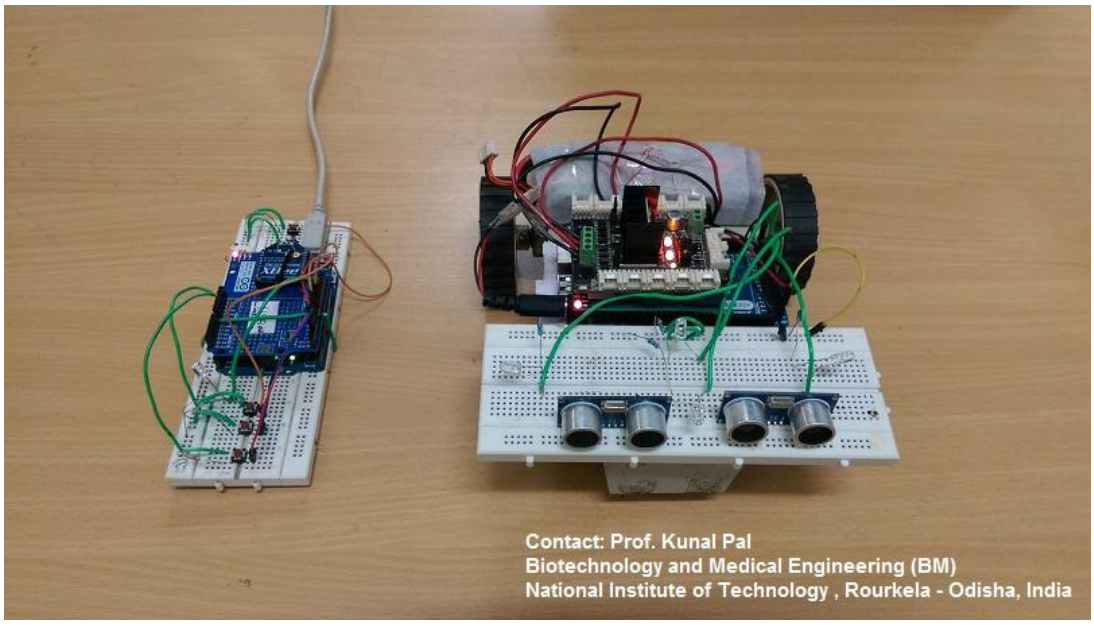

Fig 11 :Wheelchair Prototype with Xbee Remote Controller

Chapter-4 Conclusion

4.1 CONCLUSION

In the current study, a Wireless based control system for Wheelchair is developed. The Wheelchair prototype was able to detect the obstacle in front of the movement of the wheelchair and stop the wheelchair using the obstacle detector. Additionally, using the Android Application and the proposed device is capable of sending SMS. The Device can help the physically disabled person, e.g. hemiplegia and paraplegia to control the wheelchair for daily using basis.

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